

2002 CleanEnergy Seminar, Sacramento



Wolfgang Strobl Hydrogen Vehicle Research Milestones during the last 25 years

BMW Group



The Ultimate Fuel

Hydrogen H₂



- universal production and use
- lowest emission

Hydrogen-Research-Vehicles

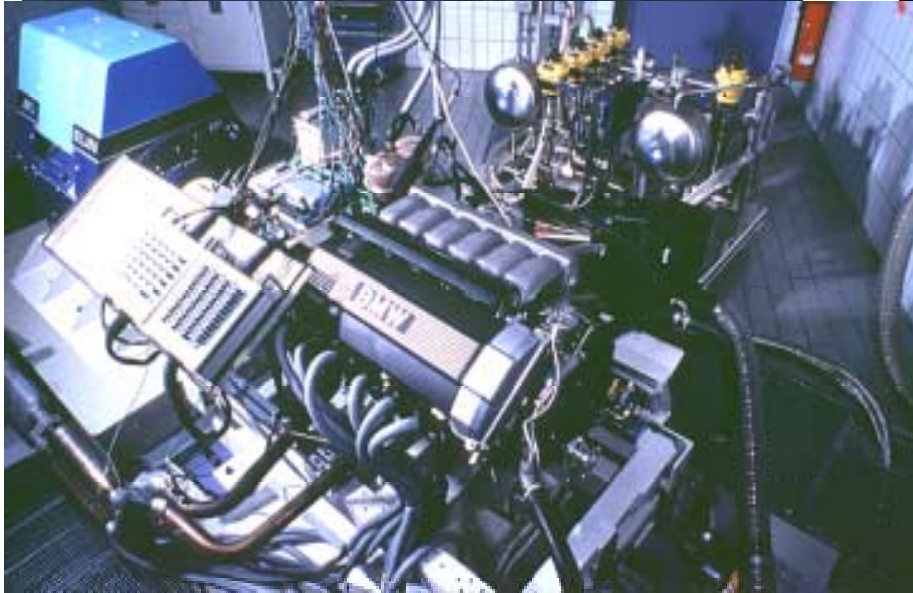
Five Generations from 1979 - 2002



Development of Liquefied Hydrogen Storage Technology



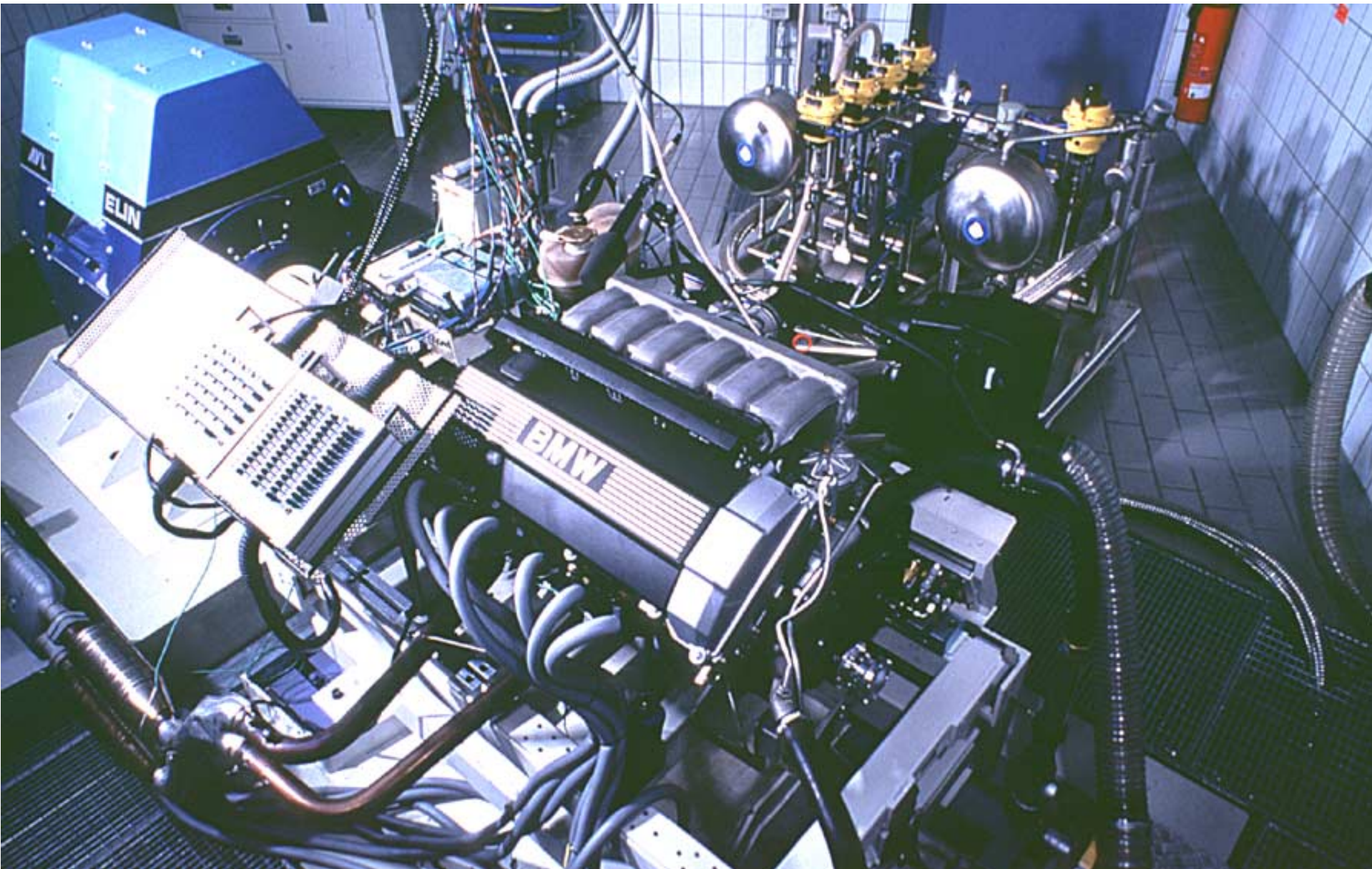
First Test Rig for Hydrogen Engines in Operation since 1989



Future Test Area for Hydrogen Technology



Hydrogen Engine Practicable Clean Power



Worst-Case-Tests with LH₂-Fuel Tanks 1992-1995



Fire-Test



Drop-mass
Impact



Pressure-Test
(all emergency-valves
blocked)

Joint Hydrogen Project of SWB (Solar-Wasserstoff-Bayern GmbH)



Fuel Cell Vehicle at SWB



- Biggest market for electric vehicles
- "Zero-Emission" for operation in halls
- Replacement for expensive battery sets
- Central hydrogen refuelling
- Trained employees

Conversion of Energy

"Each system should do what it can do best!"



Mechanical power
> 100 kW



Electricity
> 1 kW

Auxiliary Power Unit with Fuel Cell Battery for On-board Electric Power Supply

Use for customers:

**“Unlimited” supply of electricity
independent of engine operation**



- Airconditioning during stand-still
- Immediate heating/warm-up
- Communication
- Lights

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**Target: Total replacement of
alternator and lead acid
battery**

Liquid Hydrogen Filling Station of SWB



Munich Airport Hydrogen Project: First Public Hydrogen Filling Station



Refuelling by Robot



Oxnard Refuelling Station



Death Valley



Nürburgring the Worlds Most Famous Race Track



VIP-Shuttle at Munich Airprt



Hydrogen Fuelled Vehicles

Challenges to be Resolved



BMW 750hL First Hydrogen Car in Small Scale Production

